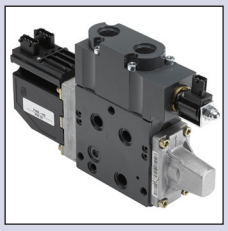
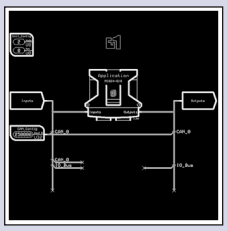
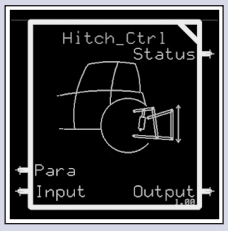
SAUER DANFOSS

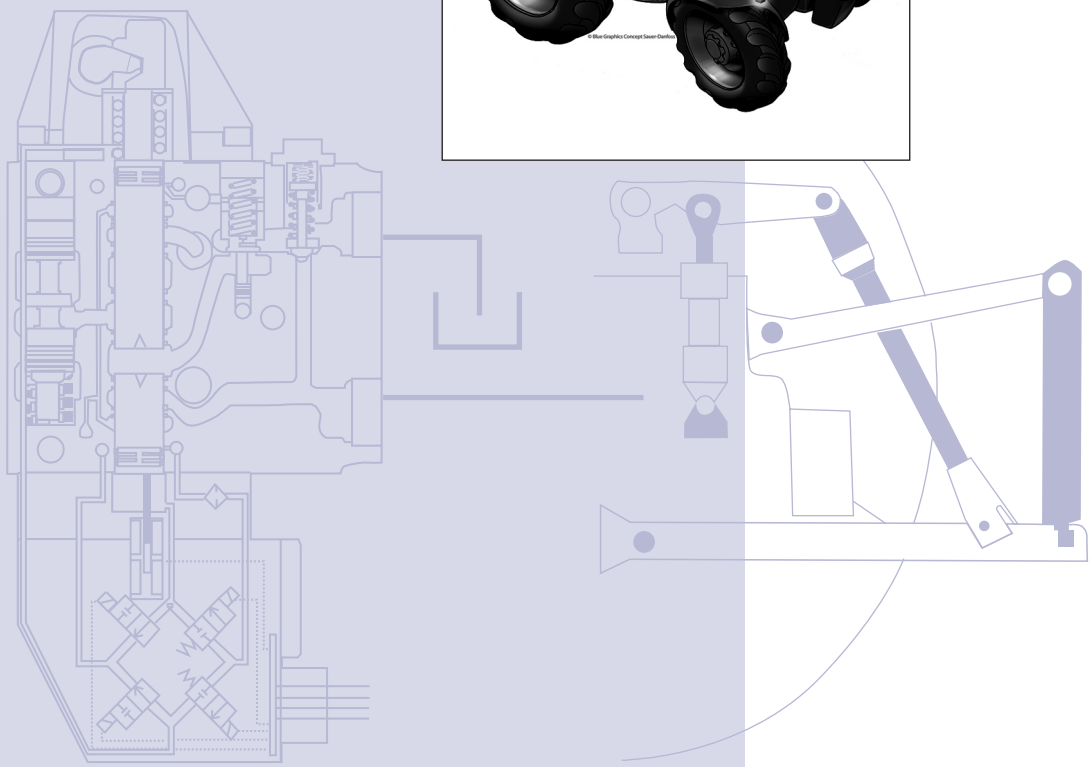
Hitch Control

System Description









Version

Revisions

Date	Page	Changed	Rev.
16 Dec, 2008			AA

© 2008 Sauer-Danfoss. All rights reserved.

Sauer-Danfoss accepts no responsibility for possible errors in catalogs, brochures and other printed material. Sauer -Danfoss reserves the right to alter its products without prior notice. This also applies to products already ordered provided that such alterations can be made without affecting agreed specifications. All trademarks in this material are properties of their respective owners. Sauer-Danfoss, the Sauer-Danfoss logotype, the Sauer-Danfoss S-icon, PLUS+1™, what really matters is inside® and Know-How in Motion™ are trademarks of the Sauer-Danfoss Group.

Front cover illustrations: F301597, 3507, 3510, F101878, Tractor_3, 3512

Hitch Control System Description

Contents

Overview
About This Document 4
Referenced Product Specific Documents 4
OEM Responsibility 5
Hitch Positioning Control Concepts 5

System Details
Closed Loop Work Control Modes 6
Closed Loop Transport Modes 7

Control Options
Overview 8
PVBZ Double Acting Actuator Control 8
PVBZ-HS Single Acting Actuator Control 8
PVBZ-HD Single and Double Acting Actuator Control 9

Hardware Components
Hitch Valves 10
Sensors 10
Microcontrollers 10

Application Software
Application Block Software Description 11
PLUS+1 GUIDE 11
PLUS+1 Service Tool 11
Customer Access to the Hitch Application Block 11

Features and Benefits
Standard Features 12
Optional Features 12
Benefits 12

Hitch Control System Description
Overview

About This Document

This document provides general information about the PLUS+1™ Hitch Control System application block. In addition, it is a reference tool for vehicle OEM design, engineering, and service personnel.

For easy access by control system developers, this document along with relevant software files, user manuals, and other documents is included in the Hitch Control Application File, **70024823.ZIP**. The application file is posted on the Sauer-Danfoss website in the PLUS+1 GUIDE (Graphic User Integrated Development Environment) downloads section.

This document is one of several sources of technical information for the hitch control system. Other sources of technical information include individual product data sheets and application block, PLUS+1 GUIDE and service tool software user manuals.

Referenced Product Specific Documents

Microcontroller Documentation

- PLUS+1 Controller Family Technical Information, **520L0719**
- PLUS+1 MC024-01A Controller Data Sheet, **11030820**

Valve Product Documentation

- PVG Proportional Valves Brochure, **520L0690**
- PVG 32 Proportional Valves Technical Information, **520L0344**
- Basic Module Type PVBZ Valve (hitch double-acting) Data Sheet, **520L0681**
- Basic Module Type PVBZ-HS Valve (hitch single-acting) Data Sheet, **520L0956**
- Basic Module Type PVBZ-HD Valve (hitch double-acting) Data Sheet, **11035599**

Software Product Documentation

- PLUS+1 GUIDE Data Sheet, **520L0708**
- PLUS+1 GUIDE User Manual, **10100824**
- PLUS+1 Service Tool User Manual, **520L0899**
- Hitch Control Application Block User Manual, **11033753**

System Start-up Procedures

- Recommended System Start-up Procedures Technical Information, **11010667**

Sauer-Danfoss product literature on-line at: www.sauer-danfoss.com

OEM Responsibility

The manufacturer of a machine or vehicle using PLUS+1™ electronic controls is responsible for correctly applying and programming GUIDE-programmable PLUS+1 products. Sauer-Danfoss strongly recommends that the OEM perform a system-level Failure Mode Effects Analysis (FMEA).

You can find additional information about OEM responsibilities in the PLUS+1 Controller Family Technical Information manual and Recommended System Start-up Procedures Technical Information manual.

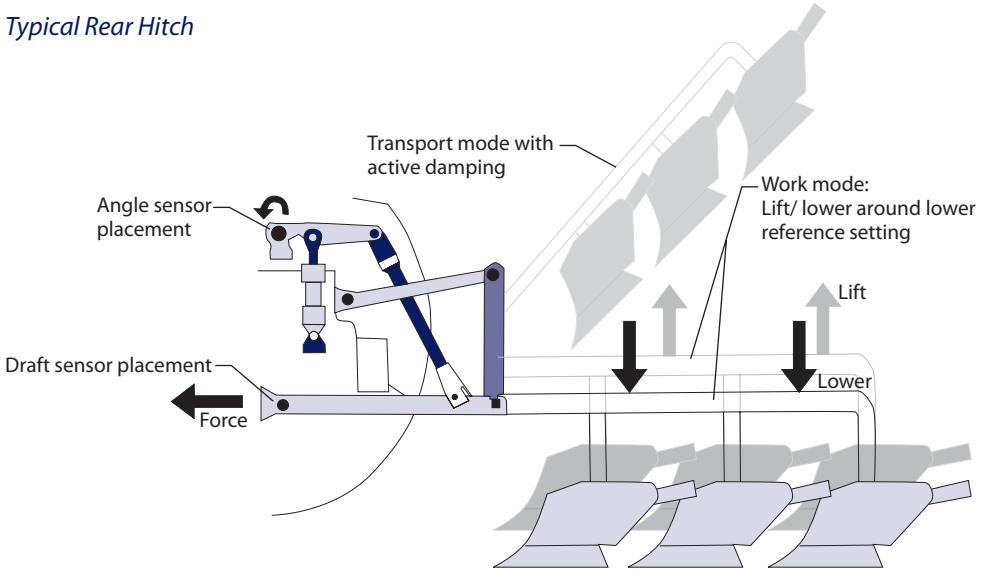
Hitch Positioning Control Concepts

The purpose of the hitch control system is to allow the operator to position the hitch linkage either in a work or transport position. Set points for transport and work are adjustable parameters. A closed loop position control compares the set-point to the actual input from the position sensor. If there is a difference, it controls the valve to lower or raise the linkage.

The goal of an automated hitch control system is to:

- Facilitate fast and easy attachment of implements to the tractor
- Optimize the tractor implement output during field operation as measured in acres/ hour or fuel consumption/acres relative to manually controlled systems
- Provide a safer and more comfortable transport of the implement between field operations

Typical Rear Hitch



3513

Closed Loop Work Control Modes

When the operator chooses work control mode, the position control adjusts the linkage to the depth reference set point.

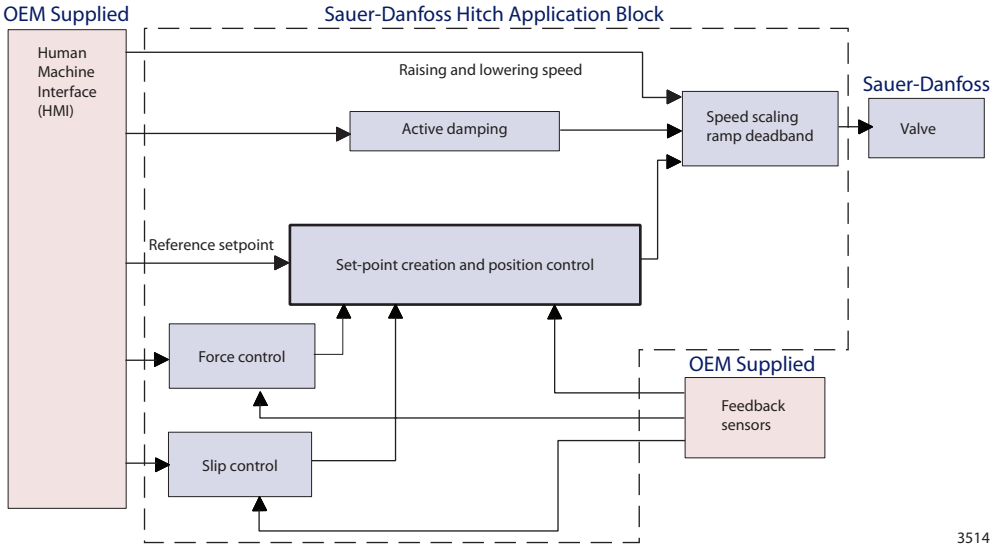
Combination of Position, Force and Slip Control

In work position it is not always possible for the tractor to do the job with the specified set point. Therefore different sensors in the system collect information about the pull force and the wheel slip.

The system compares these inputs with an operator defined preset maximum value. If the current pull force or wheel slip are higher than the preset maximum value, it calculates a delta and adds to the set point for the work position.

When the set point is increased, the pull force/wheel slip decreases, and causes recalculation of the delta. In this way, the system continually modulates the linkage position according to the sensor inputs.

Combined Position, Force and Slip Control



Adaptive Force Control

It is sometimes difficult for the operator to find the correct parameter settings for force control in some work situations. Selecting adaptive force control allows the system to automatically adjust to changing field conditions.

Closed Loop Work Control Modes (continued)

Fast Down Control

This mode gets the implement more quickly to the correct working depth.

- Single acting: This mode bypasses the closed loop control and sends the valve to maximum lowering.

Maximum lowering is still subject to scale function according to implement weight, to avoid hazardous lowering speeds.

- Double acting: This mode maintains the closed loop control. The only difference to work mode is that the digital output to switch between single and double acting, is set for double acting operation.

In-cab Control from Human Machine Interface (HMI)

You can expand the HMI with up/down buttons or a joystick for manual operation. In manual operation the operator gives direct input to the valve. This is very useful for attaching and detaching implements.

- Analog joystick: Control of the valve is proportional from zero to the specified maximum value.

- Digital buttons: If the application uses on/off buttons, pressing the appropriate button sets the valve to the specified maximum value.

Remote Operation

It is possible to operate the hitch valve with buttons outside the cab. This operation overrides any other mode, and leaves the system in safe state after operation. When back in the cab, the operator must choose desired mode.

Closed Loop Transport Modes

In transport mode, the position control adjusts the linkage to the upper limit set point.

Rear Hitch Active Damping

When traveling with a heavy implement lifted, the tractor can start to oscillate around the rear axle. The result is that the front wheels no longer have a steady contact with the road. Active damping can modulate the linkage position to offset these oscillations. Normally, the draft sensors sense these oscillations and provide the input signal to the control.

Front Hitch Active Damping

Active damping can benefit a front hitch as well as the rear hitch. You can add pressure sensors to the system to provide the necessary signals to the hitch control application block.

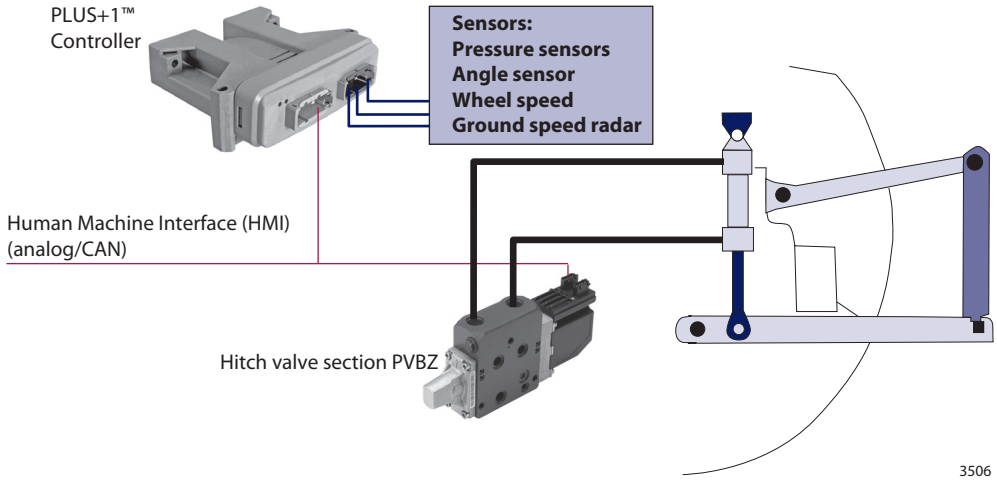
Overview

Control for single and double acting hitch control systems are combined in one software application block. This allows users to select the appropriate valve for the system. Options include single acting, double acting, and switchable (between single and double acting).

PVBZ Double Acting Actuator Control

The PVBZ meets basic market requirements for front hitches and auxiliary valves, that raise and lower implements hydraulically. This includes the float feature.

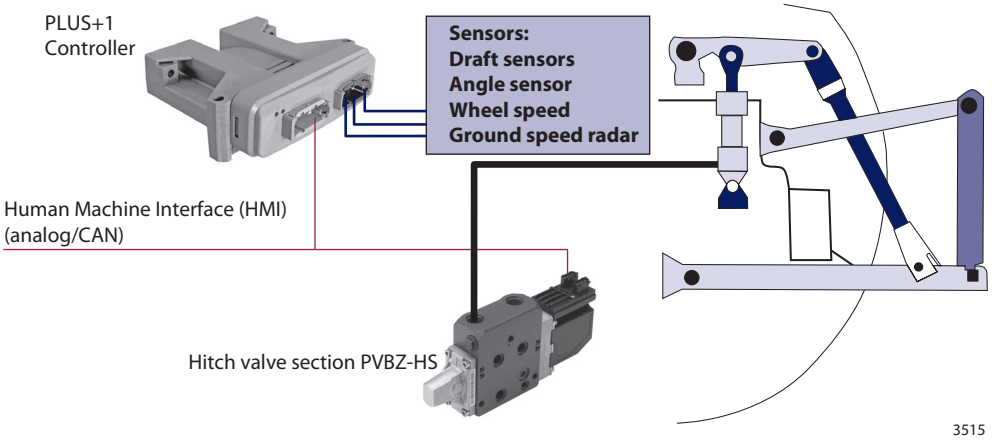
Typical Double-Acting System Used for Front Hitch



PVBZ-HS Single Acting Actuator Control

The PVBZ-HS meets market requirements for single-acting rear hitches, that raise implements hydraulically and lower them by gravity.

Typical Single-Acting System Used for Rear Hitch

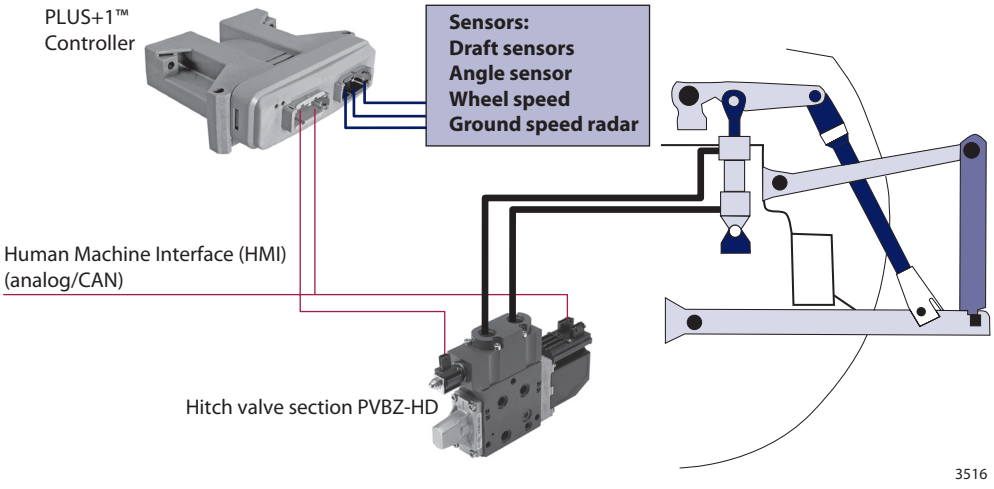


PVBZ-HD Single and Double Acting Actuator Control

The PVBZ-HD is a more advanced alternative to the PVBZ or PVBZ-HS. This valve can operate either as double-acting or single-acting.

The PVBZ-HD has the ability to raise, lower, press down, or float. In double-acting mode, the PVBZ-HD increases comfort and safety when attaching and detaching heavy implements because of its ability to raise and lower at the same speed. For field operation you may select either single or double-acting mode.

Advanced Hitch System: Capable of Switching Between Double or Single Acting



Hitch Valves

The valve options for the Sauer-Danfoss hitch control system include PVBZ double-acting, PVBZ-HS single-acting, and the PVBZ-HD single and double-acting valves. These proven PVG 32 valves feature pressure compensation, low leakage ports (P/O-check), and optional PVLP shock/anticavitation valves. These features are contained in PLUS+1™ compliant valve sections that incorporate ISO bus compatible PVED electrical actuation, making them easy to integrate into the vehicle hydraulic system.

Sensors

Following is a summary of typical sensors and recommended suppliers:

Draft Sensors for Force Control

Vendors: Bosch Rexroth, Vishay
Sensor excitation voltage requirements must be compatible with the selected PLUS+1 microcontroller power supply rating.

Angle Sensor for Displacement Control

Vendor: Honeywell
RPN Series Rotary Position Sensors use a magnetically biased Hall effect integrated circuit to accurately sense rotary movement of the actuator shaft.

Ground Speed Radar

Vendor: Dickey-john
The DICKEY-john RVSIII series Radar Velocity Sensors utilize Doppler radar technology to output a signal that is proportional to ground speed.

Microcontrollers

A wide range of keyed PLUS+1 microcontrollers are available, including 24 pin, 50 pin, and 88 pin models.

PLUS+1 Controller Power Supply Specification

Normal sensor power supply output specification for Sauer-Danfoss microcontrollers is 5 Vdc. Output current rating ranges from 200 mA to 500 mA depending on the microcontroller model you select for your application. Please refer to individual microcontroller data sheets for additional details.

MC024-01A Controller For 10 Vdc Draft Sensors

The MC024-01A is an element of the PLUS+1 family of mobile machine management products. It is a keyed general-purpose controller equally suited for use in a distributed machine control system, or as a stand-alone controller.

This controller has a 10 Vdc, 0.5 A sensor supply output for use with existing hitch sensors on the market requiring a 10 Vdc power supply.

HWD (Hardware Description File) for PLUS+1 Controllers

Sauer-Danfoss provides hardware description files (*.HWD file) for PLUS+1 microcontrollers. Each .HWD file includes the operating system software for a particular microcontroller. Select a microcontroller with input/output and power supply specifications that is suitable for your application. Then visit the Sauer-Danfoss website, download the appropriate .HWD file, and install it in your copy of GUDE.

Application Block Software Description

The hitch control application block is a graphical representation of software algorithms that provide the foundation for automated hitch control. Specific tailoring of the block is accomplished using Sauer-Danfoss PLUS+1™ GUIDE tool set. GUIDE allows developers to build application software for use with Sauer-Danfoss PLUS+1 controllers. The PLUS+1 Service Tool is used to download the compiled application to the target microcontroller.

PLUS+1 GUIDE

Customers use the hitch control application block as the starting point for a complete hitch system application that includes input mapping, calibration, fault handling, output mapping, and connection for HMI devices and microcontroller outputs.

The application block is released as a .SCS file, which means it can be dragged onto the GUIDE programming workspace to be included as the application block for a complete, user-developed hitch system application.

PLUS+1 Service Tool

The PLUS+1 Service Tool is included with the PLUS+1 GUIDE user license.

PLUS+1 Service Tool Functions

- Downloads software to keyed PLUS+1 hardware
- Transfers data from the microcontroller to a PC
- Provides interface for developing service screens for machine diagnostics, setup, and tuning

Keyed PLUS+1 Application Block Software and Application Hardware

If the application hardware key matches the application software key 10106603 the service tool permits the download to the target application hardware.

Customer Access to the Hitch Application Block

The Hitch Control Application File, **70024823.ZIP** is available for download from Sauer-Danfoss website in the PLUS+1 GUIDE downloads section.

Application File Contents

Software and documents enclosed in the application file include:

- Hitch Control Application Block, **10108138** (*.SCS)
- Hitch Control Application Block User Manual, **11033753** (*. PDF)
- Hitch Control System Description, **11036124** (*.PDF)

Application File Download and Installation in GUIDE

After downloading the application file to your hard drive, you can install the application block code in the *My Blocks* tab of the GUIDE component selector menu, for easy access during application development.

Software user manual and other technical information documents from the application file may be stored in any convenient folder on your hard drive.

Standard Features

- Single-acting and double-acting proportional valves as well as advanced multi-function valve that can switch between single and double-acting
- Available PLUS+1™ microcontroller with a 10 Vdc sensor supply voltage suitable for general market draft sensors
- Wide range of standard PLUS+1 microcontrollers with 5 Vdc sensor power supply
- Available I/O extension modules for the microcontroller to accommodate a larger number of analog signals from the HMI, if needed
- A generic, user-programmable application block software for controlling the hitch position

Optional Features

Other hitch control components, such as HMI controls and sensors, are typically OEM-specific, and are not part of the Sauer-Danfoss standard hitch control portfolio at this time. However, Sauer-Danfoss can work with customers to develop custom OEM-specific interface solutions.

In addition, Sauer-Danfoss can assist with development of complete software solutions, tailored to specific requirements of the OEM interface and HMI specifications, based on the application block that is described in this document.

Benefits

- Application block software is GUIDE programmable by end user: A complete software solution can be created by extending the application block provided by Sauer-Danfoss
- Faster and easier prototyping, set-up and tuning
- Simple logics—better user understanding
- Single or double acting system in one software application
- Double acting operation features enables higher safety and comfort
- Precise control and repeatability
- Simplified control of displacement force and slip factors
- Safer attachment and removal of implements
- Stable, closed-loop control in all operating modes

Notes

Notes

SAUER DANFOSS

Our Products

Open circuit axial piston pumps

Gear pumps and motors

Fan drive systems

Closed circuit axial piston pumps and motors

Bent axis motors

Hydrostatic transmissions

Transit mixer drives

Hydrostatic transaxles

Electrohydraulics

Integrated systems

Microcontrollers and software

PLUS+1™ GUIDE

Displays

Joysticks and control handles

Sensors

Orbital motors

Inverters

Electrohydraulic power steering

Hydraulic power steering

Hydraulic integrated circuits (HIC)

Cartridge valves

Directional spool valves

Proportional valves

Sauer-Danfoss Mobile Power and Control Systems – Market Leaders Worldwide

Sauer-Danfoss is a comprehensive supplier providing complete systems to the global mobile market.

Sauer-Danfoss serves markets such as agriculture, construction, road building, material handling, municipal, forestry, turf care, and many others.

We offer our customers optimum solutions for their needs and develop new products and systems in close cooperation and partnership with them.

Sauer-Danfoss specializes in integrating a full range of system components to provide vehicle designers with the most advanced total system design.

Sauer-Danfoss provides comprehensive worldwide service for its products through an extensive network of Global Service Partners strategically located in all parts of the world.

Local address:

Sauer-Danfoss (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239-6000
Fax: +1 515 239 6618

Sauer-Danfoss GmbH & Co. OHG
Postfach 2460, D-24531 Neumünster
Krokamp 35, D-24539 Neumünster, Germany
Phone: +49 4321 871-0
Fax: +49 4321 871 122

Sauer-Danfoss ApS
DK-6430 Nordborg, Denmark
Phone: +45 7488 4444
Fax: +45 7488 4400

Sauer-Danfoss-Daikin LTD.
Shin-Osaka TERASAKI 3rd Bldg. 6F
1-5-28 Nishimiyahara, Yodogawa-ku
Osaka 532-0004, Japan
Phone: +81 6 6395 6066
Fax: +81 6 6395 8585

11036124 • Rev AA • Dec 2008

www.sauer-danfoss.com